CLAIMS

1. A method for fabricating a multilayer optical article, comprising the steps of:

providing a first substrate with a first surface and a second surface;

providing a second substrate with a first surface and a second surface;

providing a third substrate with an first surface and a second surface;

grasping the first surface of the first substrate with a first holder, whereby the first surface of the first substrate is held to an inner surface of the first holder, the grasping performed by application of a vacuum;

grasping an first surface of the second substrate with a second holder, whereby the first surface of the second substrate is held to an inner surface of the second holder, the grasping performed by application of a vacuum;

arranging the inner surfaces of the first and second holders to face one another in a selected angular relationship;

disposing a first adherent on one or more surfaces selected from a second surface of the first substrate and a second surface of the second substrate;

at least partially curing the first adherent while the first and second holders maintain their grasp and while the inner surfaces of the first and second holders are in a selected distance relationship and the selected angular relationship to form a first multilayer article;

releasing the first holder from the first multilayer article;

grasping a first surface of the third substrate with the released first holder, whereby the first surface of the third substrate is held to an inner surface of the first holder, the grasping performed by application of a vacuum;

disposing a second adherent on one or more surfaces selected from an second surface of the third substrate and the first surface of the first substrate of the formed multilayer article;

at least partially curing the second adherent while the first and second holders maintain their grasp and while the inner surfaces of the first and second holders are in a selected distance relationship and angular relationship to form a second multilayer article;

wherein after removal of the first and second holders the at least partially cured first and second adherent maintains the second multilayer article in a

posture at which the second multilayer article was held by the first and second holders, wherein the first and second adherent comprise a photopolymer such that the article is capable of storing data in a holographic data storage system, and wherein at least one of the inner surface of the first holder and the inner surface of the second holder has a surface flatness of about 0.05 to about 1 waves/cm for wavelengths of about 0.3 to about 1.6μm.

2. The method of claim 1, wherein the second multilayer article has a surface flatness of about 0.05 waves/cm to about 1 wave/cm at wavelengths of about 300 nanometers to 1600 nanometers, and the force exerted by the adherents on the first, second, and third substrates maintains the surface flatness.

3. The method of claim 1, wherein a multilayer bounded by the first surface of the first substrate and the first surface of the second substrate and a multilayer bounded by the first surface of the first substrate and the first layer of the third substrate each have a transmission flatness of about 0.05 waves/cm to about 1 wave/cm at wavelengths of about 300 nanometers to 1600 nanometers.

4. The method of claim 1, wherein the first and second holders are glass plates having at least one vacuum groove therein.

5. The method of claim 1, wherein the first and second multilayer article have a Strehl value of 0.9 or greater.

6. The method of claim 1, wherein the first and second multilayer article have a bow of about 10^{-2} or less.

7. The method of claim 1, wherein the first, second, and third substrates are transparent and are selected from glass, sapphire, polycarbonate, quartz, polymethylmethacrylate, acrylic, polyolefin or any combination thereof.

8. The method of claim 1, wherein during the curing step at least one of the first holder and the second holder is allowed to move along the z-axis.

9. The method of claim 1, wherein the selected angular relationship is a parallel relationship.

10. The method of claim 1, wherein an interferometric technique is performed during arrangement of the inner surfaces of the holders in the selected angular relationship.

11. A multilayer optical article comprising:

a first substrate;

a second substrate;

a third substrate;

a first layer of partially cured adherent, wherein the first layer of partially cured adherent is disposed between the first surface of the first substrate and the second substrate; and

a second layer of partially cured adherent, wherein the second layer of partially cured adherent is disposed between the second surface of the first substrate and the third substrate, wherein the first and second adherent comprise a photopolymer such that the article is capable of storing data in a holographic data storage system, and wherein the multilayer optical article has a surface flatness of about 0.05 waves/cm to about 1 wave/cm at wavelengths of about 300 nanometers to 1600 nanometers, wherein a first layer bounded by a first surface of the first substrate and a first surface of the second substrate and a second layer bounded by a first surface of the first substrate and a first layer of the third substrate each have a transmission flatness of about 0.05 waves/cm to about 1 wave/cm at wavelengths of about 300 nanometers to 1600 nanometers.

12. The multilayer article of claim 11, wherein the substrates are made from glass, silicon, polycarbonate, polymethylmethacrylate, acrylic, polyolefin or any combination thereof.

13. The multilayer article of claim 11, wherein the substrates have at least one hole for dispensing an adherent through the substrate.

14. The multilayer article of claim 11, wherein the geometric form of the substrates may be square, rectangular, circular, or oval.

15. The multilayer article of claim 11, wherein the substrates are about 25 micrometers to about 3 millimeters in thickness.

16. The multilayer article of claim 11, wherein the outer surface of the first or second or third substrates contain surface relief patterns.

17. The multilayer article of claim 11, wherein one or both of the surfaces of the first or second or third substrate contain a surface relief pattern or a diffractive grating.

18. The multilayer article of claim 11, wherein the adherent is cured utilizing thermal or radiation energy.

19. The multilayer article of claim 11, wherein the article has a Strehl value of 0.9 or greater.

20. A method for fabricating a multilayer reflective holographic storage system, comprising the steps of:

providing a first substrate with a first surface and a second surface, wherein the first surface is optically reflective;

providing a second substrate with a first surface and a second surface;

providing a third substrate with an first surface and a second surface;

grasping the first surface of the first substrate with a first holder, whereby the first surface of the first substrate is held to an inner surface of the first holder, the grasping performed by application of a vacuum;

grasping an first surface of the second substrate with a second holder, whereby the first surface of the second substrate is held to an inner surface of the second holder, the grasping performed by application of a vacuum;

arranging the inner surfaces of the first and second holders to face one another in a selected angular relationship;

disposing a first adherent on one or more surfaces selected from a second surface of the first substrate and a second surface of the second substrate;

at least partially curing the first adherent while the first and second holders maintain their grasp and while the inner surfaces of the first and second holders are in a selected distance relationship and the selected angular relationship to form a first multilayer article;

releasing the first holder from the first multilayer article;

grasping a first surface of the third substrate with the released first holder, whereby the first surface of the third substrate is held to an inner surface of the first holder, the grasping performed by application of a vacuum;

disposing a second adherent on one or more surfaces selected from an second surface of the third substrate and the reflective first surface of the first substrate of the formed multilayer article;

at least partially curing the second adherent while the first and second holders maintain their grasp and while the inner surfaces of the first and second holders are in a selected distance relationship and angular relationship to form a second multilayer article;

wherein after removal of the first and second holders the at least partially cured first and second adherent maintains the second multilayer article in a posture at which the second multilayer article was held by the first and second holders, wherein the first and second adherent comprise a photopolymer such that the article is capable of storing data in a reflective holographic data storage system, and wherein at least one of the inner surface of the first holder

and the inner surface of the second holder has a surface flatness of about 0.05 to about 1 waves/cm for wavelengths of about 0.4 to about 0.7 μm.

21. The method of claim 20, wherein the second multilayer article has a surface flatness of about 0.05 waves/cm to about 1 wave/cm at wavelengths of about 300 nanometers to 1600 nanometers, and the force exerted by the adherents on the first, second, and third substrates maintains the surface flatness.

22. The method of claim 20, wherein a multilayer bounded by the first surface of the first substrate and the first surface of the second substrate and a multilayer bounded by the first surface of the first substrate and the first layer of the third substrate each have a transmission flatness of about 0.05 waves/cm to about 1 wave/cm at wavelengths of about 300 nanometers to 1600 nanometers.

23. The method of claim 20, wherein the first and second holders are glass plates having at least one vacuum groove therein.

24. The method of claim 20, wherein the first and second multilayer article have a Strehl value of 0.9 or greater.

25. The method of claim 20, wherein the first and second multilayer article have a bow of about 10^{-2} or less.

26. The method of claim 20, wherein the first, second, and third substrates are transparent and are selected from glass, sapphire, polycarbonate polymethyl methacrylate, polyolefin, or quartz.

27. The method of claim 20, wherein during the curing step at least one of the first holder and the second holder is allowed to move along the z-axis.

28. The method of claim 20, wherein the selected angular relationship is a parallel relationship.

29. The method of claim 20, wherein an interferometric technique is performed during arrangement of the inner surfaces of the holders in the selected angular relationship.

30. A method for fabricating a multilayer reflective holographic storage system, comprising the steps of:

grasping the outer surface of a first substrate with a first holder, whereby the outer surface of the first substrate is held to an inner surface of the first holder, the grasping performed by application of a vacuum;

grasping an outer surface of a second substrate with a second holder, whereby the outer surface of the second substrate is held to an inner surface of the second holder, the grasping performed by application of a vacuum;

arranging the inner surfaces of the first and second holders to face one another in a selected angular relationship;

disposing a first adherent on one or more surfaces selected from an inner surface of the first substrate and an inner surface of the second substrate;

at least partially curing the first adherent while the first and second holders maintain their grasp and while the inner surfaces of the first and second holders are in a selected distance relationship and the selected angular relationship to form a first multilayer article;

releasing the first holder and/or second holder from the first multilayer article;

depositing or coating a reflective material on the outer surface of the first substrate of the first multilayer article;

grasping an outer surface of the third substrate with the released first holder, whereby the outer surface of the third substrate is held to an inner surface of the first holder, the grasping performed by application of a vacuum;

disposing a second adherent on one or more surfaces selected from an inner surface of the third substrate and the reflective outer surface of the first substrate of the formed multilayer article;

at least partially curing the second adherent while the first and second holders maintain their grasp and while the inner surfaces of the first and second holders are in a selected distance relationship and angular relationship to form a second multilayer article; wherein after removal of the first and second holders the at least partially cured first and second adherent maintains the second multilayer article in a posture at which the second multilayer article was held by the first and second holders, wherein the first and second adherent comprise a photopolymer such that the article is capable of storing data in a reflective holographic data storage system, and wherein at least one of the inner surface of the first holder and the inner surface of the second holder has a surface flatness of about 0.05 to about 1 waves/cm for wavelengths of about 0.3 to about 01.6μm.

31. The method of claim 30, wherein the second multilayer article has a surface flatness of about 0.05 waves/cm to about 1 wave/cm at wavelengths of about 300 nanometers to 1600 nanometers, and the force exerted by the adherents on the first, second, and third substrates maintains the surface flatness.

32. The method of claim 30, wherein a multilayer bounded by the first surface of the first substrate and the first surface of the second substrate and a multilayer bounded by the first surface of the first substrate and the first layer of the third substrate each have a transmission flatness of about 0.05 waves/cm to about 1 wave/cm at wavelengths of about 300 nanometers to 1600 nanometers.

33. The method of claim 30, wherein the first and second holders are glass plates having at least one vacuum groove therein.

34. The method of claim 30, wherein the first and second multilayer article have a Strehl value of 0.9 or greater.

35. The method of claim 30, wherein the first and second multilayer article have a bow of about 10^{-2} or less.

36. The method of claim 30, wherein the first, second, and third substrates are transparent and are selected from glass, sapphire, polycarbonate, polymethylmethacrylate, polyolefin, quartz.

37. The method of claim 30, wherein during the curing step at least one of the first holder and the second holder is allowed to move along the z-axis.

38. The method of claim 30, wherein the selected angular relationship is a parallel relationship.

39. The method of claim 30, wherein an interferometric technique is performed during arrangement of the inner surfaces of the holders in the selected angular relationship.

40. A multilayer reflective holographic storage system comprising:

a first substrate with a first and second surface, wherein the first surface is optically reflective

a second substrate;

a third substrate;

a first layer of partially cured adherent, wherein the first layer of partially cured adherent is disposed between the first surface of the first substrate and the second substrate; and

a second layer of partially cured adherent, wherein the second layer of partially cured adherent is disposed between the second surface of the first substrate and the third substrate,

wherein the first and second adherent comprise a photopolymer such that the article is capable of storing data in a reflective holographic data storage system, and wherein the multilayer storage system has a surface flatness of about 0.05 waves/cm to about 1 wave/cm at wavelengths of about 300 nanometers to 1600 nanometers, wherein a multilayer bounded by the first surface of the first substrate and the first surface of the second substrate and a multilayer bounded by the first surface of the first substrate and the first layer of the third substrate each have a transmission flatness of about 0.05 waves/cm to about 1 wave/cm at wavelengths of about 300 nanometers to 1600 nanometers.

41. The multilayer article of claim 40, wherein the substrates are made from glass, silicon, polycarbonate, polymethylmethacrylate, acrylic, polyolefin or any combination thereof.

42. The multilayer article of claim 40, wherein the substrates have at least one hole for dispensing an adherent through the substrate.

43. The multilayer article of claim 40, wherein the geometric form of the substrates may be square, rectangular, circular, or oval.

44. The multilayer article of claim 40, wherein the substrates are about 25 micrometers to about 3 millimeters in thickness.

45. The multilayer article of claim 40, wherein the outer surface of the first or second or third substrates contain surface relief patterns.

46. The multilayer article of claim 40, wherein the inner surface of the first or second or third substrate contain a surface relief pattern or a diffractive grating.

47. The multilayer article of claim 40, wherein the adherent is cured utilizing thermal or radiation energy.

48. The multilayer article of claim 40, wherein the article has a Strehl value of 0.9 or greater.